U.S. DEPARTMENT OF ENERGY

DOE User Facilities for Energy Technologies

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US Department of Energy

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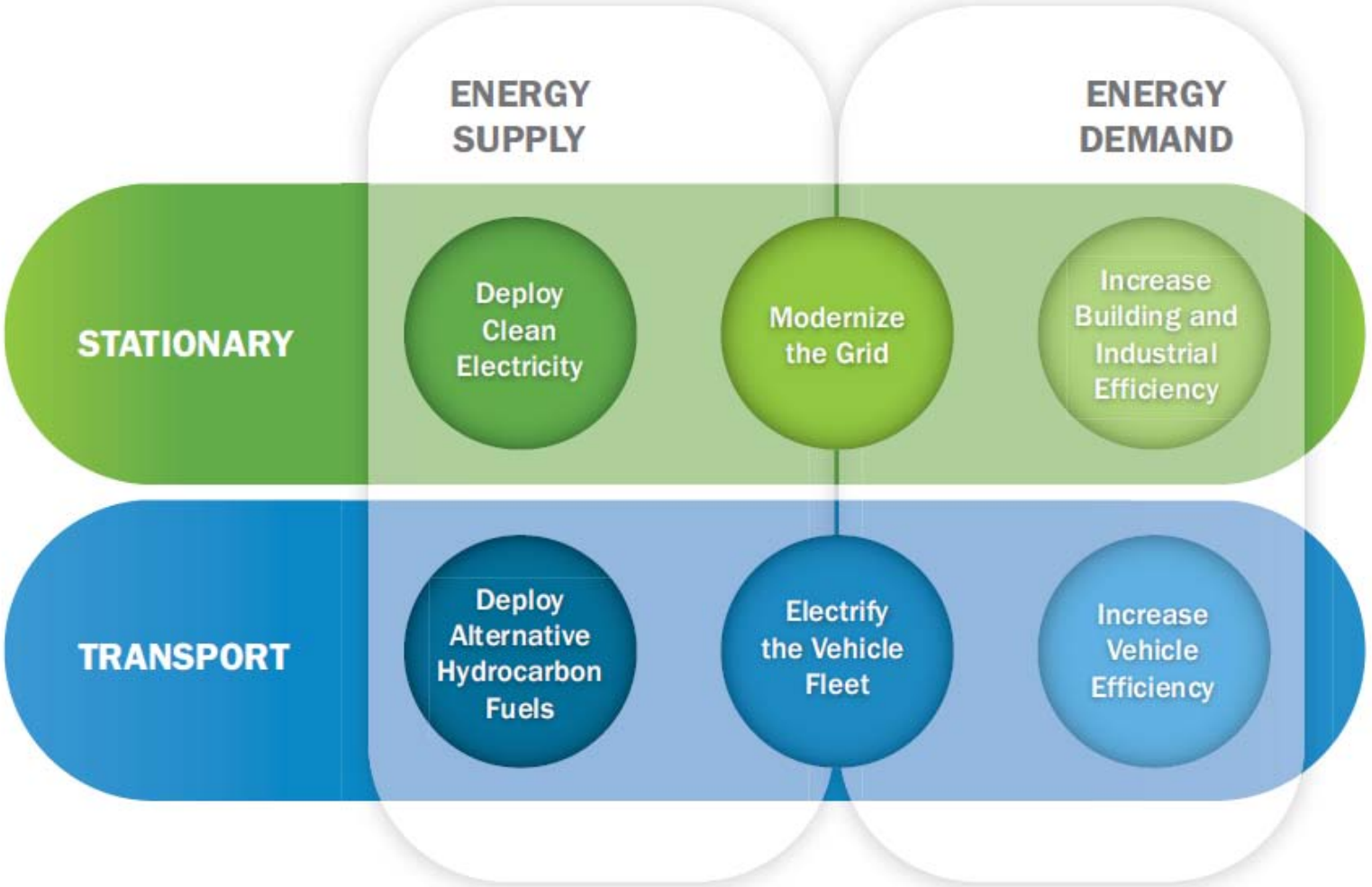
Six Strategies



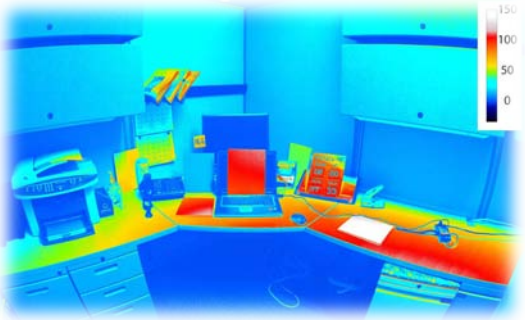
www.energy.gov/QTR

U.S. DEPARTMENT OF ENERGY

Stationary: Technology Headroom for DOE

Building and Industrial Efficiency

- Data collection and usage
- Integrated systems analyses
- Next-gen processes and products



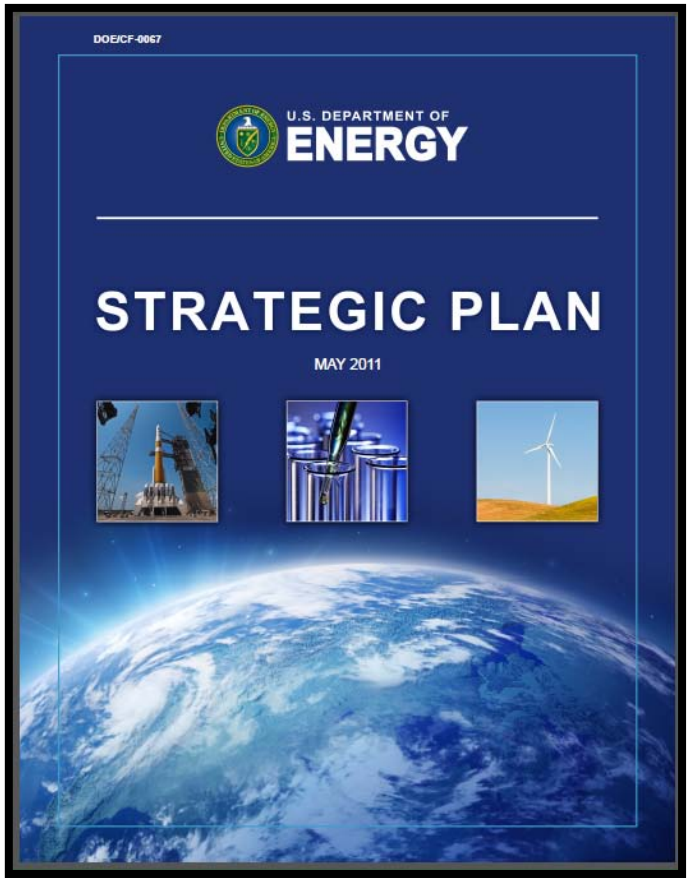
Grid Modernization

- Communication and data
- Management and control
- Energy storage

Clean Power

- Drive down costs
- Coupling between energy and water use
- Increase modularity and scalability
- Infrastructure compatibility

Recognizing the need for Technology user facilities



"The Department has a core competency in the design, development, construction, and operation of unique world-class user facilities that benefit the entire U.S. research community…"

"Successful characterization of new technology at scale can reduce risks and speed adoption…"

"The Department will make [energy technology] testbed and demonstration capabilities available to researchers and industry alike…"

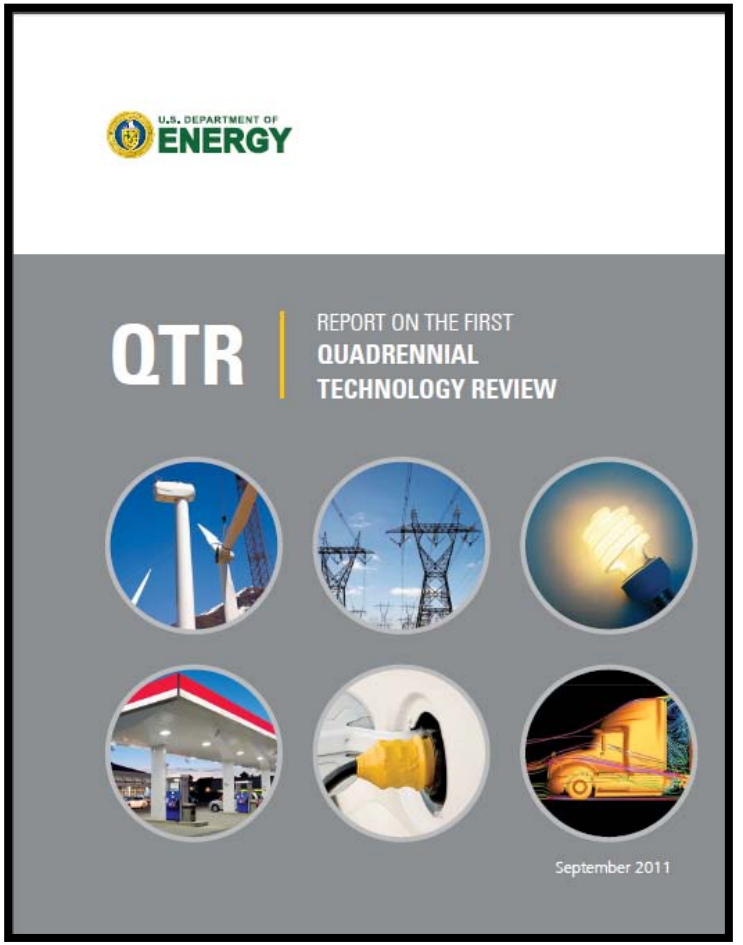
"[The Department will] complete at least two new national technology user facilities by 2015."

Recognizing the need for Technology user facilities

"Collectively [DOE technology facilities] are one of the Department's most important tools for accelerating energy technologies."

"…the most familiar [user] facilities are… built and operated primarily by the Office of Science… Less well known are the facilities supported by the energy technology R&D programs at many of the national laboratories."

The four DOE technology offices will undertake a review of their policies, with input from the relevant academic and industrial research communities, for facility access, operations, and budgeting with a goal of ***maximizing their benefit to energy technology development"***



Science user facilities as an example – *Access to all*

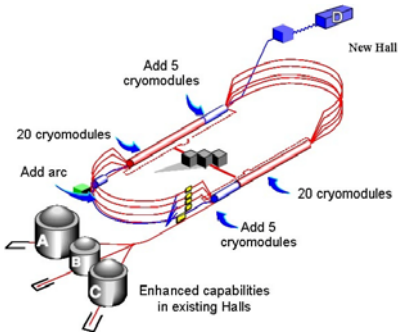
- Facilities supported by the Office of Science
  - Half of $4.9B annual budget supports user facilities
  - equipment, facility construction, and facility operations
- 25,000 users in FY2010:
  - ~50% University, ~30% labs, ~20% industry
- Access and review procedures are designed to accommodate breadth and diversity of users needs

Molecular Foundry

Jaguar Supercomputer

Examples of SC Open-Access Science User Facilities

- **Five photon (light) sources**
  - APS, ALS, NSLS, SSRL, LCLS
- **Three high-flux neutron sources**
  - SNS, HFIR, Lujan
- **Three electron beam microcharacterization centers**
  - EMCMR, NCEM, SHaRE
- **Five nanoscale science centers**
  - CNMS, MF, CINT, CFN, CNM
- **Three high-performance computing facilities**
  - NERSC, OLCF, ALCF
- **Several high-energy physics and nuclear physics facilities**
  - Tevatron, CEBAF, RHIC, ATLAS, HRIBF
- **Multiple biological and environmental facilities**
  - EMSL, JGI, ARM
- **Three fusion research facilities**
  - DIII-D, Alcator C-Mod, NSTX



Diverse Access for Diverse Users
Example: Advanced Photon Source

- Collaborative Access Team member access –
  - Beamlines funded by industry are given up to 75% of availability facility time
  - Remaining 25% of time reserved for general users
  - **Industrial Macromolecular Crystallography Association** - the business of macromolecular crystallography
- APS staff access –
  - 20% of facility time on beamilines operated by the Laboratory is made available to research staff for maintenance, upgrades, and discretionary research
- General User access –
  - General access is managed through a centralized and peer reviewed proposal (PRP) process.
  - Proposal Review Panels are scientific peers primarily external to APS staff.
- Partner User access –
  - PRP reviewed access for up to 30% of available time on general user access.

http://centraldocs.aps.anl.gov/policy_procedures/user/

Diverse Access for Diverse Users
Example: Computing Allocation

- Facility directors will retain up to 10% of allocable hours to support pilot or startup projects, to support code scaling and for petascale computer science and performance metrics research.
- The majority (60-85%) of available processor hours on the Leadership Computing resources are allocated through the INCITE program.
  - Industry applicants are judged for merit against common INCITE criteria
  - 5-30% of resources at each ASCR facility are reserved for ASCR Leadership Computing Challenge (**ALCC**) projects, designated as high-risk, high payoff projects in areas directly related to DOE's energy mission.

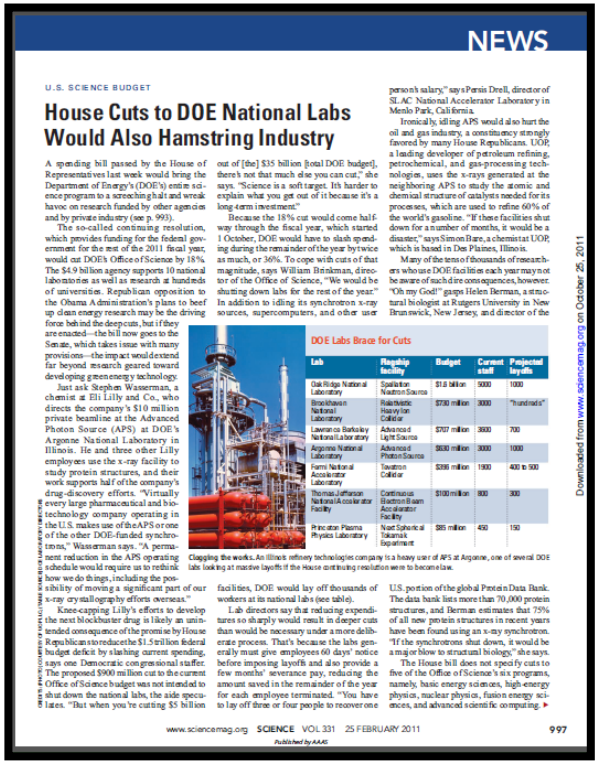
Industry impact –

44 of the Fortune 500 companies conduct hundreds of research projects at DOE Office of Science user facilities

http://www.nufo.org/files/MASTERFortune_500_SC_users.pdf

Master List
Fortune 500 companies that use National User Facility Organization (NUFO) facilities for research

Rank	Institution	City	State	Zip	Country	Facility	Description of work
2	Exxon Mobil	284,650.00	19,280.00				
	Exxon Mobil Process Research Laboratories	Baton Rouge	LA	70821	USA	APS	Collect XANES data for sulfur transformation characterization on various materials associated with fuel processing
	Exxon Research & Engineering Company	Annandale	NJ	08801	USA	APS	See above.
	ExxonMobil Chemical Company	Baytown	TX	77520	USA	APS	See above.
3	Chevron	163,527.00	10,483.00				
	Chevron Mining, Inc.	Mountain Pass	CA	92366	USA	APS	Using high-resolution synchrotron XRD with in-situ heating capability at the APS 11-BM beamline, the structural transformations of various clay and mica samples are tracked in real-time by a step-wise procedure on the same starting sample.
	Chevron Research and Technology Company	Richmond	CA	94802	USA	ALS	Work covered by a non-disclosure agreement.
	ChevronTexaco Inc.	Houston	TX	77042	USA	APS	See above
4	General Electric	156,779.00	11,025.00				
	General Electric	Niskayuna	NY	12309	USA	ALS	Gas sensor materials from GE have been studied by using Ni L-edge and La M-edge XAS as part of a DOE funded Industrial Technology program. The Awarded project was "Heirarchical Nanoceramics for Industrial Process Sensors" with a funding of $3.3M for three years.
	General Electric	Niskayuna	NY	12309	USA	ALCF	Understanding the complex turbulent mixing noise sources for wind turbine airfoils and jet exhaust nozzles is critical to delivering the next-generation of "green," ;pw-noise wind turbines and jet engines. GE Global Research scientists are using the IBM Blue Gene/P supercomputer at the ALCF to develop and prove predictions of noise to characterize these hard to measure acoustic sources.
	General Electric	Niskayuna	NY	12309	USA	OLCF	GE is studying unsteady flows in the blade rows of turbomachines and comparing those results to current steady flow solutions to see if it can lead to more energy efficient designs.
	General Electric Medical Systems	W. Milwaukee	WI	53219	USA	LANSCE	High-volume production of isotopes
	General Electric	Niskayuna	NY	12309	USA	OLCF	GE is using supercomputers at the OLCF to investigate fundamental processes in advanced gasification technology with carbon capture. Advanced gasification has the potential to more efficiently generate lower cost electricity with reduced emissions compared to existing coal fired power plants.
	General Electric Medical Systems	W. Milwaukee	WI	53219	USA	APS	The experiments involve in situ EXAFS and XANES on ORR electrocatalysts.
8	Ford Motor	118,308.00	2,717.00				
	Ford Motor Company	Dearborn	MI	48124	USA	ALS	Works done at beamline 9.0.2 in collaboration with a group from Sandia investigating combustion of fuels.



NEWS

U.S. SCIENCE BUDGET

House Cuts to DOE National Labs Would Also Hamstring Industry

A spending bill passed by the House of Representatives last week would bring the Department of Energy's (DOE's) entire science program to a screeching halt and wreak havoc on research funded by other agencies and by private industry (see p. 993).

The so-called continuing resolution, which provides funding for the federal government for the rest of the 2011 fiscal year, would cut DOE's Office of Science by 18%. The $4.9 billion agency supports 10 national laboratories as well as research at hundreds of universities. Republican opposition to the Obama Administration's plans to beef up clean energy research may be the driving force behind the deep cuts, but if they are enacted—the bill now goes to the Senate, which takes issue with many provisions—the impact would extend far beyond research geared toward developing green energy technology.

Just ask Stephen Wasserman, a chemist at Eli Lilly and Co., who directs the company's $10 million private beamline at the Advanced Photon Source (APS) at DOE's Argonne National Laboratory in Illinois. He and three other Lilly employees use the x-ray facility to study protein structures, and their work supports half of the company's drug-discovery efforts. "Virtually every large pharmaceutical and biotechnology company operating in the U.S. makes use of the APS or one of the other DOE-funded synchrotrons," Wasserman says. "A permanent reduction in the APS operating schedule would require us to rethink how we do things, including the possibility of moving a significant part of our x-ray crystallography efforts overseas."

Knee-capping Lilly's efforts to develop the next blockbuster drug is likely an unintended consequence of the promise by House Republican to reduce the $1.5 trillion federal budget deficit by slashing current spending, says one Democratic congressional staffer. The proposed $900 million cut to the current Office of Science budget was not intended to shut down the national labs, the aide speculates. "But when you're cutting $5 billion out of [the] $35 billion [total DOE budget], there's not that much else you can cut," she says. "Science is a soft target. It's harder to explain what you get out of it because it's a long-term investment."

Because the 18% cut would come halfway through the fiscal year, which started 1 October, DOE would have to slash spending during the remainder of the year by twice as much, or 36%. To cope with cuts of that magnitude, says William Brinkman, director of the Office of Science, "We would be shutting down labs for the rest of the year." In addition to idling its synchrotron x-ray sources, supercomputers, and other user facilities, DOE would lay off thousands of workers at its national labs (see table).

Lab directors say that reducing expenditures so sharply would result in deeper cuts than would be necessary under a more deliberate process. That's because the labs generally must give employees 60 days' notice before imposing layoffs and also provide a few months' severance pay, reducing the amount saved in the remainder of the year for each employee terminated. "You have to lay off three or four people to recover one person's salary," says Persis Drell, director of SLAC National Accelerator Laboratory in Menlo Park, California.

Ironically, idling APS would also hurt the oil and gas industry, a constituency strongly favored by many House Republicans. UOP, a leading developer of petroleum refining, petrochemical, and gas-processing technologies, uses the x-rays generated at the neighboring APS to study the atomic and chemical structure of catalysts needed for its processes, which are used to refine 60% of the world's gasoline. "If these facilities shut down for a number of months, it would be a disaster," says Simon Bare, a chemist at UOP, which is based in Des Plaines, Illinois.

Many of the tens of thousands of researchers who use DOE facilities each year may not be aware of such dire consequences, however. "Oh my God!" gasps Helen Berman, a structural biologist at Rutgers University in New Brunswick, New Jersey, and director of the

DOE Labs Brace for Cuts

Lab	Flagship facility	Budget	Current staff	Projected layoffs
Oak Ridge National Laboratory	Spallation Neutron Source	$1.8 billion	5000	1000
Brookhaven National Laboratory	Relativistic Heavy Ion Collider	$730 million	3000	"hundreds"
Lawrence Berkeley National Laboratory	Advanced Light Source	$707 million	3600	700
Argonne National Laboratory	Advanced Photon Source	$630 million	3000	1000
Fermi National Accelerator Laboratory	Tevatron Collider	$396 million	1900	400 to 500
Thomas Jefferson National Accelerator Facility	Continuous Electron Beam Accelerator Facility	$100 million	800	300
Princeton Plasma Physics Laboratory	Nuel Spherical Tokamak Experiment	$95 million	450	150

Clogging the works. An Illinois refinery technologies company is a heavy user of APS at Argonne, one of several DOE labs looking at massive layoffs if the House continuing resolution were to become law.

The House bill does not specify cuts to five of the Office of Science's six programs, namely, basic energy sciences, high-energy physics, nuclear physics, fusion energy sciences, and advanced scientific computing. ▶

U.S. portion of the global Protein Data Bank. The data bank lists more than 70,000 protein structures, and Berman estimates that 75% of all new protein structures in recent years have been found using an x-ray synchrotron. "If the synchrotrons shut down, it would be a major blow to structural biology," she says.

Published by AAAS

Entire industries depend on Department of Energy capabilities

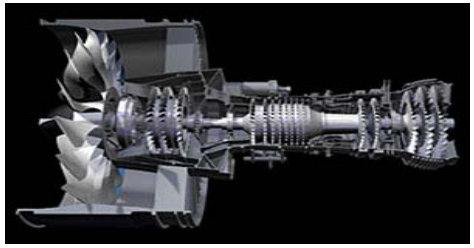
"Virtually every large pharmaceutical and biotechnology company operating in the U.S. makes use of the APS or one of the other DOE-funded synchrotrons."

-- Sephen Wasserman, Eli Lilly and Co.

U.S. DEPARTMENT OF ENERGY

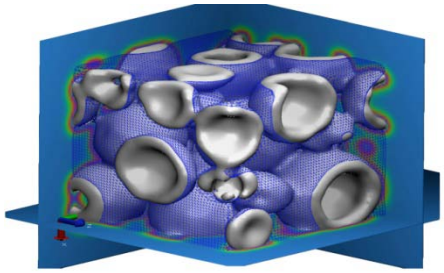
Industry Impact - *Computing*

Pratt & Whitney
A United Technologies Company



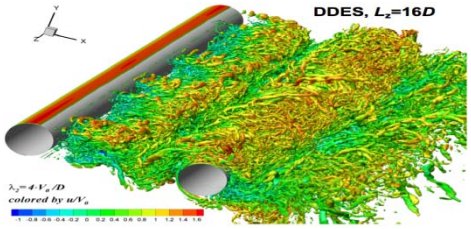
- Pratt and Whitney using “virtual testing” to accelerate improvements in jet engine design, dramatically decreasing problem-solution turnaround times in development of PurePower™ engine.
- The new-generation engine improves fuel burn by 12-15%, with a potential savings to airlines of nearly $1M per aircraft per year. It also cuts carbon emissions by 3,000 tons per aircraft per year while reducing other emissions 50%.

P&G

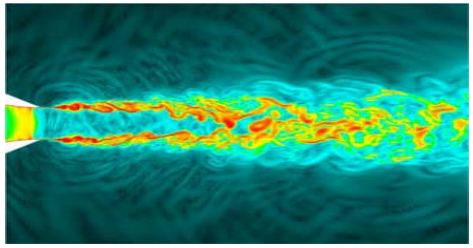


- P&G was able to study the complex interactions of billions of atoms and create simulations to determine how tiny submicroscopic structures impact the characteristics of the ingredients in soaps, detergents, lotions and shampoos.
- Understanding these processes accelerates the development of many consumer goods, foods, and fire control materials.

BOEING



- Boeing simulated the turbulence created by aircraft landing gear and calculated the noise caused by two cylinders placed in tandem in an air stream. This uses state of the art turbulence-resolving CFD for massively separated flows.
- Boeing expects these capabilities to contribute to the design of safe and quiet technologies.



- GE Global Research simulated the complex turbulent flows that generate aerodynamic noise during takeoff to validate the accuracy of a large eddy simulation solver.
- The simulations are considered by GE to be critical for developing next-generation, “green” (low-emission) aircraft.

Energy Technology User Facilities

- Access should be given to the best research ideas that can advance the state of understanding and technology.
- Management practice must be well defined so all can understand how and when they can gain access to the capability
  - NAS Report – *Cooperative Stewardship: Managing the Nation's Multidisciplinary User Facilities* http://www.nap.edu/catalog.php?record_id=9705
- Management should include multiple mechanisms to be flexible enough to provide access across users, with clearly defined requirements and goals
- Selection criteria is critical to a successful user facility

How can ESIF define a space and selection criteria that are both of scientific interest and relevant to industry?